The CRUSHED STONE JOURNAL

In This Issue

■

Facts for the Crushed Stone Salesman

■

Stabilization of the Highway Program

March-April • 1932

Official Publication
NATIONAL CRUSHED STONE ASSOCIATION

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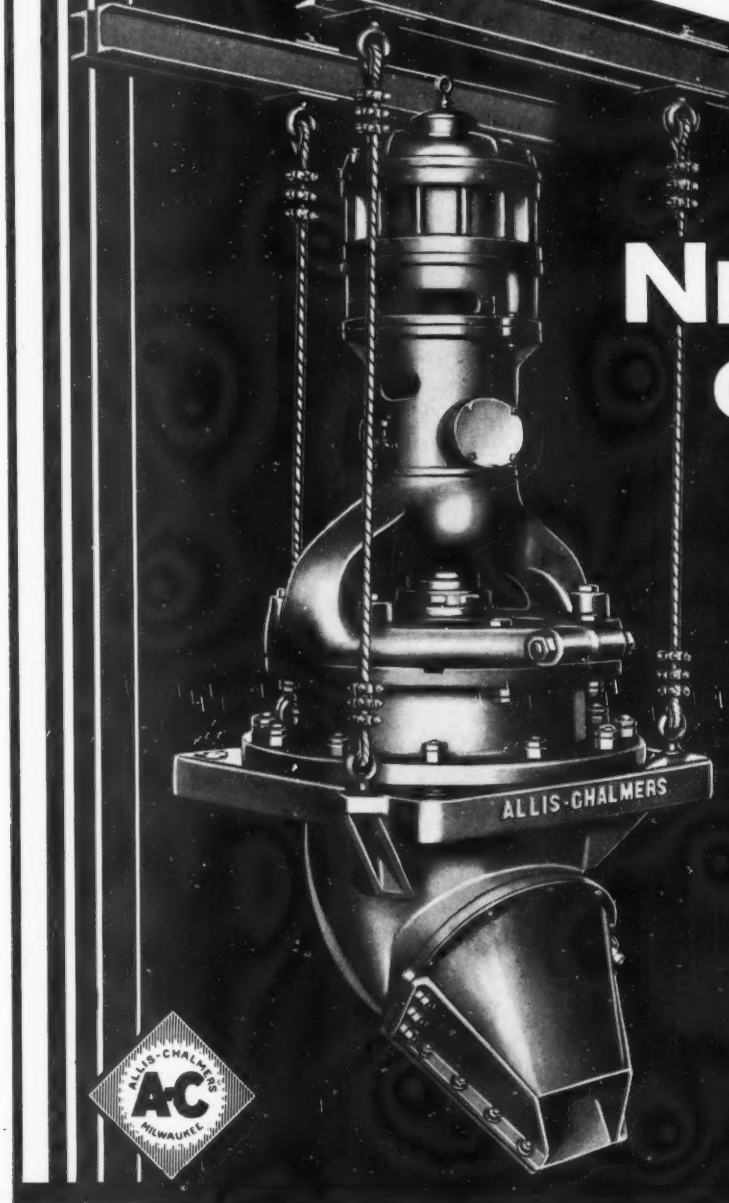

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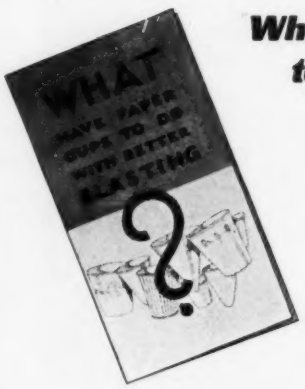

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J. R. BOYD, Editor

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SYMONS CONE CRUSHERS

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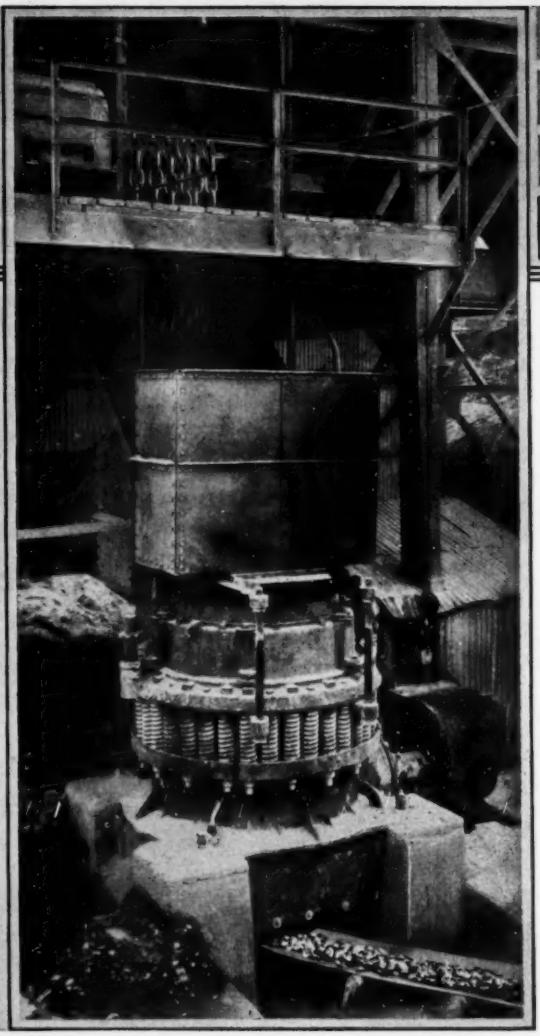

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THE
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Facts for the Crushed Stone Salesman[1]

By A. T. GOLDBECK
Director, Bureau of Engineering,
National Crushed Stone Association

Introduction

EVERY salesman probably recognizes it as a fundamental principle of efficient salesmanship that he should thoroughly know the product he is selling. He desires to create a want for his product and to that end he must know why it should be used. He must be familiar with its strong points, its limitations and the results which it will produce when used in different ways. He must know all of its possibilities in order that he may be able to justify it. He should not be content merely to quote prices and freight rates and the daily tonnage which his plant might be able to ship to the job.

Certain facts with regard to crushed stone and its uses are of importance and I hope to set before you at least some of these facts. Obviously, in so short a time, it will be impossible to discuss all of the facts with which you should be familiar, even though I were capable of so difficult a task. I fully realize that to most of you I shall merely repeat what you already know, but if I give you one or two facts which you might find helpful in your sales efforts, I shall feel amply repaid.

General Knowledge of Rock Deposits

In order to sell stone, the salesman doesn't have to be acquainted with the intricacies of the geological formation or of the mineralogical composition of his material, nor does he have to be acquainted with the methods used in determining the physical properties of rock, except in a very general sort of way. There are certain terms, such as the percentage of wear, specific gravity, toughness, absorption, hardness and sodium sulphate test with which the salesman should be on speaking terms. Then, too, he should be familiar enough with the general classification of his rock to know whether it is of igneous, sedimentary or metamorphic origin. Certainly, also, he should know its family name, that is, whether it is a basalt, dolomite, granite, etc. Dr. E. C. E. Lord, petrographer for the U. S. Bureau of Public Roads, gives the following general classification of rocks in his bulletin entitled, "Examination and Classification of Rocks for Road Building."

TABLE I

Class	Type	Family
I. Igneous	1. Instrusive (plutonic)	a. Granite
		b. Syenite
		c. Diorite
		d. Gabbro
		e. Peridotite
	2. Extrusive (volcanic)	a. Rhyolite
		b. Trachyte
		c. Andesite
		d. Basalt & diabase
II. Sedimentary	1. Calcareous	a. Limestone
		b. Dolomite
	2. Siliceous	a. Shale
		b. Sandstone
		c. Chert (flint)
III. Metamorphic	1. Foliated	a. Gneiss
		b. Schist
		c. Amphibolite
	2. Nonfoliated	a. Slate
		b. Quartzite
		c. Eclogite
		d. Marble

Of the above table, the trap rocks are andesite, basalt, diabase, rhyolite, diorite and gabbro. In general, the name "trap" is applied to the fine grained, dark colored, igneous rocks. Limestone, dolomite and sandstone are of sedimentary origin while granite, quartzite, and others, have resulted from the alteration or metamorphosis of these two types and hence are known as metamorphic rocks. Rock classification is a study in itself which the salesman need not undertake in any detail. For the most part, crushed stone which is used commercially consists of the limestones and dolomites, some sandstones among the sedimentary

[1] Presented at the Fifteenth Annual Convention of the National Crushed Stone Association held at the William Penn Hotel, Pittsburgh, Pa., January 19-22, 1932.

rocks, all of the various forms of trap rock and granite, quartzite, and marble, with a scattering of still other types.

Physical Properties of Rock

Except for special uses, the quality of crushed material is determined by means of physical tests. There are cases where chemical tests likewise are important, such, for instance, in rocks used for fluxing stone and other chemical purposes. These physical tests have been thoroughly described[2] and to those of you who are not familiar with these test methods, in a general way at least, I advocate that you refer to the published information on this subject.

The use of crushed stone covers a wide field and for the sake of orderly presentation, several of the important facts will be taken up under certain main classifications. In presenting these facts I hope to show you some of the advantages in the use of crushed stone, likewise to point out some of its limitations and deficiencies. I hope to give you information which you might use in your discussions with your prospective clients.

A. Concrete

There are certain fundamental conceptions we should all have with regard to concrete. In the first place, concrete is the mass which results from the mixing together of aggregates, Portland cement and water. The Portland cement paste made from the mixture of water and Portland cement is the glue which sticks the aggregates together and more or less fills the pore spaces between the aggregate. I say, more or less, because, unfortunately, all of the water which is mixed with the concrete materials does not and cannot combine with the Portland cement and, therefore, it remains in the concrete mass until it evaporates. When it does finally evaporate, pore or void spaces are left within the mass, equal to the volume of water which has disappeared. If we merely used enough water in the concrete mixture to combine with the cement, concrete would not be a practical material for use, for we should never be able to place it and finish it properly and so the excess water is necessary to create proper workability or consistency in the concrete mass.

We must think of concrete, then, as being a mixture of dry cement, sand and coarse aggregate, intermingled in the presence of enough water to make the concrete a uniformly plastic mass in which there are no voids. The wetter we make the concrete, the greater will be its volume, but furthermore, the greater will be its porosity when the excess water evaporates. It has been established that the greater the quantity of water used with the cement, the weaker is the resulting cement paste which acts as the glue. Excess water is to be avoided, for it not only decreases the strength of the glue, but it adds to the porosity of the concrete and therefore decreases its durability.

The important points to notice are: First, that the water plays a most important role in influencing the volume, the strength, the porosity and durability of concrete.

Second: That when a mass of concrete is newly mixed, it contains no voids except for a very small percentage of air bubbles. Its total volume is made up of the summation of the solid portions of each of the ingredients composing the concrete, that is, the water, cement, fine and coarse aggregates. This fact is important to the stone producer because he frequently meets with the term "yield" of concrete and so it becomes necessary for him to know what is meant by that term and he should be able to perform the calculations necessary to determine concrete "yield."

By "yield" is meant the volume of concrete produced per bag of cement in the mixture. This volume may be determined with considerable accuracy by calculation. The principle used in the calculation of yield dates back to the time of Archimedes, that renowned Greek philosopher, who was commissioned by his king to determine if he had not been cheated in the new crown which his goldsmith had just made for him. Archimedes, whose mind was never at rest, discovered while taking a bath, that his body displaced water equal to his own weight and the story goes that he immediately dashed through the streets of ancient Athens crying out, "Eureka!" (*I have found it.*)

What he had found was the principle that a body immersed in water looses weight equal to the weight of water displaced. Incidentally, he found that gold was not the only metal composing the King's crown. From Archimedes' discovery there resulted the term "specific gravity" which means the weight of a substance as compared with the weight of an equal volume of water. The expression for this term, algebraically, reads as follows:

$$\text{Specific Gravity} = \frac{W}{V \times 62.4} \qquad (1)$$

Where W = the weight of the material in pounds.
V = the volume of the material in cubic feet.

From the above equation we obtain the equation that:

$$V = \frac{W}{\text{specific gravity} \times 62.4} \qquad (2)$$

In this form the equation serves a very useful purpose.

Things are not what they seem. A bag of cement, for instance, which seems so solidly full is found to have actual solid cement in it occupying only about 50 per cent of the volume of the bag; the remaining 50 per cent is air voids. Correspondingly, a cubic foot of sand is made up, in part, of air voids, and in part of solid particles of sand. The same statement may be made of a cubic foot of crushed stone.

In calculating the yield of concrete we are interested only in the solid parts of the constituent concrete ingredients. For, as we have said, it is the summation

[2] See The Results of Physical Tests of Road Building Rock, U. S. Dept. of Agriculture Miscellaneous Publications, No. 76, and also, the "A. A. S. H. O. Tentative Standard Specifications for Highway Materials and Methods of Sampling and Testing."

of these solid portions of the ingredients which makes up the volume of concrete produced. We must, therefore, be able to calculate the solid portions, or solid volumes of the materials entering into concrete.

Making use of formula No. 2, $V = \frac{W}{\text{specific gravity} \times 62.4}$

and applying this to a sack, or one cubic foot of Portland cement weighing 94 pounds, and having a specific gravity of 3.12, we find that the solid volume of the cement in the sack equals 94 lbs. divided by 3.12 x 62.4 equals 0.485 cubic feet. That is to say, in a cubic foot of cement there is actually only 0.485 cubic feet of solid cement present and that means there must be one minus 0.485 or 0.515 cubic feet of air voids.

Suppose we wish to calculate the yield of concrete containing one bag of cement, 2 cubic feet of sand, having a weight of 100 pounds per cubic foot and a specific gravity of 2.65, combined with 4 cubic feet of stone having a weight of 90 pounds per cubic foot and a specific gravity of 2.70. We must know the amount of water used and let it be assumed that the so called water-cement ratio is 0.7; that means 0.7 cubic feet of water for each bag of cement or 0.7 times 7.5 equals 5.25 gallons per bag.

The following example illustrates the method of calculating the yield.

Proportions 1:2:3½, dry, loose volumes.
Water-ratio 0.7
Cement—wt. = 94 lbs. per bag or cubic foot, specific gravity = 3.12
Sand—wt. = 100 lbs. per cu. ft., specific gravity = 2.65, Solid weight per cubic foot = 2.65 x 62.4 = 165 pounds
Stone—wt. = 90 lbs. per cu. ft., specific gravity = 2.70, Solid weight per cubic foot = 2.70 x 62.4 = 168 pounds

$$\text{Solid Volume} = \frac{\text{Weight}}{\text{Apparent Specific Gravity} \times 62.4}$$

Materials	Cubic Feet of Solid Volume
Cement, $\frac{1 \times 94}{3.12 \times 62.4}$	= 0.48
Sand, $\frac{2 \times 100}{2.65 \times 62.4}$	= 1.21 x 165 = 200 lbs.
Stone, $\frac{3\frac{1}{2} \times 90}{2.70 \times 62.4}$	= 1.87 x 168 = 314 lbs.
Water	= 0.70
Yield	= 4.26 cu. ft. of concrete per bag of cement

In a cubic yard of concrete (27 cu. ft.) there will be $\frac{27}{4.26}$ = 6.33 bags of cement.

Cement, 27/4.26 = 6.33 bags
Sand, 200 lbs. x 6.33 = 1266 lbs. = 0.633 tons.
Stone, 314 lbs. x 6.33 = 1980 lbs. = 0.990 tons.

The above method of calculation for yield may be used no matter what method is specified for proportioning the concrete and the question which no doubt is uppermost in your minds is, What is the yield of crushed stone concrete as compared with gravel concrete or slag concrete? There are various methods of proportioning concrete and the answer to that question depends, in part, on what method of proportioning is specified. It also depends, in part, on the percentage of voids in the coarse aggregate, which in turn is dependent on the angularity of the material and on the gradation. If the materials are specified by dry, loose volume, as in the above example, that coarse aggregate which has the lowest percentage of voids is quite apt to have the highest yield of concrete per bag of cement. On the other hand, if the proportions are so stated that a given number of bags of cement per cubic yard must be used, the question of yield does not enter, for in that case no matter what aggregates are used the cement content per cubic yard will be the same in all cases.

There are specifications written making use of the so called water-cement ratio method of proportioning concrete. As a rule this specification takes the form of a specified maximum water-cement ratio and a maximum slump in the slump test for measuring consistency. For illustration, it may be specified that the concrete shall be so proportioned that there shall be not more than 5½ gallons of water per bag of cement and that the slump as measured by the standard slump test shall not exceed a given amount, say 2.0 inches. In this case, as a rule, the aggregate which has the greatest workability, in other words, that aggregate which requires the least amount of water to produce a given slump is the one which will have the largest yield.

There is still another method of proportioning concrete now being used, known as the mortar-voids theory. In this case the strength of the concrete is supposed to be dependent entirely upon the strength of the mortar and the coarse aggregate is looked upon merely as a filler; the greater the voids in the coarse aggregate, the higher the mortar content, and since the proportions of the mortar are the same, irrespective of the coarse aggregate, that aggregate which has the least amount of voids is the one which will have the greatest yield per bag of cement. However, it is found in practice that this is not always the case, especially with small size gravel. Here the mortar content must be increased to obtain proper workability.

Except in that method of proportioning which calls for a given cement content per cubic yard of concrete, it is incumbent upon stone producers to do everything possible to reduce their voids by good gradation. Gravel, as it occurs in nature is very frequently deficient in the larger sizes and the commercial gradation must be much the same as it naturally occurs. Stone, on the other hand, can be well-graded, artificially and, consequently, notwithstanding its angularity, it can be made to have a lesser percentage of voids than some gravels.

There is another factor which helps out the yield of the stone concrete, namely, the fact that a somewhat higher water content must be used with the angular crushed stone than with gravel to obtain a given degree of workability or consistency. This extra water helps

to swell the volume of concrete produced and, consequently, increases the yield per bag of cement. It is difficult to make any general statement with regard to the comparative yields, for each case is a case unto itself; so much depends upon the characteristics of the individual aggregates and on the type of specification used. However, the method above given will enable one to calculate the yield no matter what the conditions are and it is advocated that all salesmen thoroughly acquaint themselves with this method for it will be found to be invaluable.[3]

B. Beam Tests of Concrete

For the past six years we have been advocating that concrete be tested making use of beam specimens whenever the concrete is to be used for highway construction. This is logical for the theory of the design of concrete highways is based upon its beam strength and, although formerly the quality of concrete for highways was tested entirely for its compressive strength, at the present time a large number of the states have swung over into the beam method of testing, many of them using both methods and many of them using the beam strength results to determine when to open the concrete road. *The beam resistance of crushed stone concrete, particularly when compared with smooth silicious gravel concrete, is high, and it is not only good engineering but it is to the advantage of crushed stone producers and to the tax paying public to advocate the beam method of testing concrete for use in highways.* The same strength can be obtained with a great many crushed stone concretes with a much lower cement content than with many of the gravel concretes. There are exceptions here and there, of course. The following table taken from our bulletin No. 7 illustrates this point.

TABLE II

Table Illustrating the Wide Range in Cement Content Required with Various Aggregates to Obtain Approximately the Same Beam Strength at 7 Days.

No.	Coarse Aggregate	Cement Bags per Cu. Yd.	7 day Beam Strength (Modulus of Rupture)
2	Stone	5.45	571
3	Gravel	6.69	555
5	Stone	5.83	514
6	Gravel	6.57	553
7	Stone	5.60	505
8	Gravel	5.24	523
9	Stone	5.50	559
12	Gravel	6.49	557
13	Stone	5.81	591
17	Gravel	6.46	590
23	Stone	5.63	515
24	Gravel	5.82	544
27	Stone	5.44	530
28	Gravel	6.71	544
29	Gravel	5.55	517
32	Stone	5.93	535
31	Gravel	8.60	516
35	Stone	5.17	509

[3] See Useful Information of May 15, May 22 and June 12, 1931.

Although, as a general rule, crushed stone makes concrete of higher beam strength than gravel concrete, the same statement cannot be made with regard to the compression test. Sometimes the crushed stone is of higher strength and sometimes the gravel is the higher of the two. No general statement can be made on this point, for much depends upon the individual characteristics of the aggregate under consideration. Crushing strength, however, is becoming less and less significant in concrete design. Very seldom does a concrete structure fail because of lack of compressive strength unless this be brought about by improper conditions such as low temperature and improper curing.

C. Workability

There are a number of points which are frequently brought up in connection with the coarse aggregate in concrete which I shall attempt to discuss briefly. One of these points is the question of workability. *By workability is implied the ease with which the concrete may be handled and properly placed in the forms and properly finished.* There can be no question that the workability of concrete is influenced to a very considerable extent by the internal friction in the concrete mass; that is to say, the ease with which the particles composing the concrete move with respect to one another during the placing and finishing.

There is no gainsaying the fact that angular fragments cannot be moved over one another with the same ease as rounded fragments. However, crushed stone concrete can be made practically as workable as gravel concrete if proper precautions are taken to proportion the concrete correctly. As a rule, this means that there must be enough sand present to sufficiently separate and lubricate the coarse aggregate. The gradation of the coarse aggregate likewise plays a most important part. In concrete highway construction a lack of workability is sometimes experienced because of the use of too large a maximum size of stone. *Material passing through the 2½ inch round opening screen is about as large as should be used. Lack of workability can also result from the use of too high a percentage of particles of the No. 8 to ⅜ inch size.* This produces a grainy mass, difficult to finish properly. *Recent tests by the Bureau of Public Roads have shown some surprising results with regard to the relative workability of gravel and stone concrete.*

A very large series of tests was completed in the field at Arlington, Virginia, making use of a number of different proportions of both stone and gravel concrete and also some slag concrete. Different gradations of gravel and of stone were employed. Slabs were formed and later these slabs were broken up into beams and tested and the amount of honey-combing at the bottoms of the slabs was determined. *It was found that small size gravel produced concrete which was nowhere near as workable as that resulting from a good grade of stone, extending from ¼ to 2½ inches*

in size. The amount of honey-combing present was taken as a measure of the respective workabilities and it was found that the gravel concrete, made with small size gravel had several times as much honey-combing present as the crushed stone concrete. This honeycombing affects the beam strength considerably and to that extent is detrimental. Much of the commercial gravel is of small size and in order to make this material work properly it is necessary to use much more sand than is necessary with the large size crushed stone. The conclusions of the Bureau of Public Roads' tests bearing on this point read as follows:

"3. The workability and uniformity in strength of the concrete was decreased in proportion to the amount of coarse aggregate added.

"4. The workability of the concrete was greatly reduced by decreasing the maximum size and at the same time increasing the amount of fines in the gravel coarse aggregate, even though the corresponding variations in the percentage of voids in the gravel and in the value of $\frac{b}{b_o}$ for the concrete were small.

"5. For the gravel concrete the reduction in workability for any mix caused by the use of the poorly graded gravel was greater than the reduction in workability caused by increasing the percentage of coarse aggregate in the concrete containing the well graded material.

"9. In order to obtain satisfactory uniformity and freedom from honeycomb it was necessary to use a consistency corresponding to a slump of approximately 2 to 3 inches.

"11. For concrete reasonably free from honeycomb, the strength of the control beams appeared to be a satisfactory measure of the strength of the corresponding pavement slab.

"12. Neither the amount of honeycombing observed in the drilled cores or the crushing strengths developed by the drilled cores measured the extent of honeycomb in the pavement slabs or the flexural strength developed by the pavement slabs."

Incidentally, the relative beam strengths of the stone concrete and the gravel concrete used in these tests showed the stone to have a far superior strength over that of the gravel for equal cement content, thus, in this instance, bearing out our own tests in this respect. *Apparently the stone concrete containing aggregate of ¼ to 2½ inch size makes a better concrete slab, freer from honeycomb than is possible with gravel concrete of comparatively small size, ¼ to 1¼ inches.* This is quite contrary to the general conception but the Bureau of Public Roads' tests were extensive enough to be quite conclusive.

In connection with the workability of slag concrete, it might be said that, as a general rule, blast furnace slag when graded in the same manner as crushed stone has a somewhat higher percentage of voids owing to the surface voids present in the slag. Consequently, a greater volume of mortar must be used to obtain equal workability. Even then, because of the wide range in weight of slag particles, slag concrete often gives trouble in finishing due to the light particles floating to the surface continually. It very frequently happens also that when concrete is proportioned by weight and the slag runs unusually light in unit weight, it is found that the finishing of the concrete becomes practically impossible, without discarding a certain amount of the coarse particles from the concrete. In this case a lesser weight of slag should be used to obtain the desired degree of workability. This, of course, would increase the cement content of the slag concrete over that of the stone concrete having a like degree of workability.

D. Shrinkage of Concrete

Those who are interested in concrete highway construction know that certain kinds of materials produce expansion and contraction more than others. For illustration, it seems to be outstanding that both slag and gravel concrete show more cracking than stone concrete. It is also observed that slag concrete has often caused trouble due to excessive moisture expansion which has caused so called "blow-ups" in concrete highways and concrete bases. *Tests conducted in our own laboratory to determine the relative amounts of expansion and contraction of slag concrete and limestone concrete, showed that certain slag concretes do expand more under the action of moisture than certain stone concretes and likewise when the moisture dries out they shrink a correspondingly greater amount. This seems to be especially true of light slags.*

In the March, 1931, issue of *The Crushed Stone Journal* we have shown that the lighter the slag, the more expansion and contraction may be expected. The light slag under 70 lbs. showed roughly from 0 to 75 per cent greater expansion than either the limestone or the heavy slag while intermediate slags, weighing between 70 and 80 pounds, which are very widely used, showed up to 50 per cent greater expansion than the stone concrete or the heavy slag concrete. Almost all of the slag concretes, however, expanded more than the stone concretes investigated. These tests were not conclusive and more investigation work is needed on the various grades of stone but the results which have been obtained are certainly borne out in practice. *They are highly important in that they indicate the necessity of the use of more frequent expansion joints in slag concrete roads than in stone concrete roads. To be on the safe side I would advocate at least half again as many joints per mile in the slag concrete as in the stone concrete. Three of the state highway departments have recognized this difference in the expansion of different kinds of concrete due to the difference in coarse aggregate used, by the inclusion of more expansion joints. This is logical and this point should be stressed by stone producers in various state highway departments.*

E. Fire Resistance

Much investigation work has been done on the resistance of concrete to fire, the concrete being made with different kinds of coarse aggregates. It is outstanding that crushed stone concretes are far superior to silicious gravel concretes when subjected to fire

and as the result of numerous experiments which have been performed by the U. S. Bureau of Standards and in The Fire Underwriters Laboratory, the *Building Code Committee of the United States Department of Commerce, in issuing their preliminary code, have required a greater thickness of fire protection for structural steel and for reinforcing steel when silicious gravel is used than is the case when either limestone or trap rock is used. Furthermore, in recognition of the serious danger of spalling of silicious gravel concrete under fire action, the Building Code Committee has required the use of mesh reinforcement in the gravel concrete but not in the stone concrete in the layer of fire protection material. Accordingly, columns when built of gravel concrete must be thicker; must contain more concrete than when stone is used.* This is a point which is decidedly in favor of stone producers, and architects throughout the country and building inspection departments should be made familiar with the building code of the U. S. Department of Commerce.

F. Permeability

The question often arises as to the relative permeability of stone concrete and gravel concrete whenever large concrete dams are under consideration. This is a question which need give no concern whatever for it is a decidedly easy matter to make concrete impermeable to water pressure, no matter what aggregate is used. Concrete specimens only 6 inches thick will withstand several hundred pounds of water pressure with no leakage. *Any concrete structure, such as a concrete dam, which will be subjected to any such pressure as this would have a thickness of several hundred feet and if there is any leakage, it occurs not because of the coarse aggregate, but rather because of the defects in the placing of the concrete.* These are structural defects in which the aggregate plays no part whatever.

The question often arises as to whether limestone is a fit material for use in concrete dams. The answer is "yes, by all means," if the material is known to be sound and weather resistant. As a matter of fact, the least resistant material in almost any concrete is the Portland cement paste and not the coarse aggregate and particularly is this so in concrete such as is used in large masonry structures where the mix is comparatively lean and a comparatively large amount of water is used in the mixture.

G. Effect of Dust-coated Stone

Dust-coated stone has at some time or another caused trouble for practically every stone producer in the country. Engineers object to coatings of dust on stone for several reasons. In the first place, they claim that a coating of dust interferes with the proper bond of stone with the mortar and thereby weakens the concrete. Also, the claim is made that when the dust occurs in the concrete, it is likely to be worked to the surface and, in the case of the concrete road, that the surface layer is thereby weakened and is apt to peel or scale off. Furthermore, it is claimed by engineers that it is impossible for them to distinguish between real stone dust and clay which may become mixed with the stone as the result of improper stripping or from the presence of clay seams.

In the case of bituminous construction, the claim is made that a coating of dust interferes with the proper bond between the bituminous cement and the stone.

Reverting to the presence of dust on crushed stone for use as a coarse aggregate in concrete, there does not seem to be much real information on this subject. In our own laboratory we have made investigations in which we purposely coated the stone with dust using a percentage as high as 5.7, which is roughly three times as much dust as would occur in a very dusty stone We found that dust coated stone had practically no effect on either the crushing strength or the modulus of rupture of concrete. *Roughly, there was a slight decrease in strength, equivalent to 1 or 1½ per cent for each per cent of dust present. This means that with a very badly coated stone which might have at the most 2 per cent of dust, there would be a falling off in strength of only 2 to 3 per cent and this decrease in strength seems to be due entirely to the fact that the presence of the dust necessitates the use of a slightly increased amount of mixing water, thereby producing a higher water ratio with its well known effect, namely, a decrease in strength in proportion to the amount of extra water used in the mix.* This slight decrease is much less than the unavoidable variation in results obtained in testing supposedly uniform concrete.

There may be certain types of stones, such for instance as oolitic limestone, which has a fracture in which the stone dust seems to become embedded and from which it is not readily displaced in the concrete mixing operation. With such stones, there is the possibility of a decrease in the bond between the mortar and the stone with a consequent falling off in strength, but these cases, I believe, are rare.

With regard to the claim that the dust comes to the surface and thereby causes a weakened surface layer, I have found that this is not true as determined by the resistance to wear under a special wear test. Dust up to as high as 5.7 per cent produced no more wear on the surface of the concrete than occurred in concrete with practically no dust in the stone. The present-day mixtures of concretes are much dryer than was formerly the case and in these dry mixes there is no tendency for the dust to migrate from the lower portions of the concrete to the upper layer and, in fact, the dust may have been a beneficial effect in holding the water in place. It has often been noted that extremely clean sand, having no fine particles, does not retain the water, whereas when fine particles are present the water is held uniformly distributed

throughout the mass and this is beneficial in keeping the concrete in a uniform condition during the hardening operation. My own opinion, based on tests and on field observation, is that stone dust, as it occurs on crushed stone produced under reasonably good conditions should not be detrimental when occurring on aggregate for use in concrete.

With regard to dust coatings on stone for use in bituminous work, especially for bituminous macadam and for surface treatment, I am of the opinion that the dust is harmful, especially when the bituminous material is applied hot. I do not believe it is extremely harmful when used with the more fluid bituminous material such as tars and bituminous emulsions.

No matter what we may think, there is an undoubted tendency among engineers to desire cleaner and cleaner stone and I would strongly advocate that stone producers recognize this demand and do their utmost in producing stone of the highest possible quality so far as cleanliness is concerned. This may not require washing for possibly a dry means of cleaning may be satisfactory. As a rule, a rinsing operation at the end of the screening should be satisfactory, for stone dust is not particularly plastic and is readily displaced. Clay coatings, on the other hand, are not readily displaced and will require that the stone be scrubbed.

H. Effects of Unsound Stone

Of recent years testing engineers have been paying more attention to the testing of unsound materials. They make use of an accelerated test, known as the sodium sulphate soundness test, in which they immerse the stone in a saturated solution of sodium sulphate. This causes crystals of sodium sulphate to grow within the pores of the stone and if it is unsound, these crystals will force the stone apart and cause it to crack, spall and flake off. Five cycles of the sodium sulphate test are ordinarily employed on stone for use as an aggregate in concrete and 20 cycles when the stone is to be used for sewage trickling filters. Freezing tests are also performed in some laboratories. Unquestionably, certain stones are unsound in the sense that they will break down upon exposure to the weather and there is no question that certain stones have caused concrete to disintegrate. *Fortunately, engineers are beginning to realize that the accelerated soundness test is to be regarded merely as a danger signal for there are numerous instances where stone has failed in the test but has not caused trouble in service.* There are two general types of failure of stone in service, one in which it merely disintegrates without exerting any expanding force, such as happens sometimes in the case of certain argillaceous limestones and shales. Other types of stones, when they are acted upon by frost, expand with considerable force and this type disrupts the concrete. Certain types of chert are notorious in this respect. Other types of chert, on the other hand, are found to be harmless. *The surest way of determining the soundness or unsoundness of stone is its behavior on long exposure to the weather as on a quarry face. No one knows definitely how many alternations of the sodium sulphate test, or of the freezing test are equivalent to the conditions of exposure to which the stone is subjected and under such circumstances accelerated tests should be regarded merely as a warning and the true indication of soundness should be taken from the service behavior of structures in which the stone has been used, or from the behavior of the stone when long exposed in the quarry. The best informed engineers use this practice.*

I. Flat and Elongated Pieces

Most specifications contain a clause to the effect that stone shall contain not more than a given percentage of flat and elongated pieces. As a rule, no definition is given of what is meant by flat and elongated pieces but the assumption is made that such fragments are harmful. Referring first to flat and elongated fragments in concrete aggregates, experiments made in our own laboratory and in that of the National Sand and Gravel Association have both pointed in the same direction, namely, *that flat and elongated fragments are not harmful when used in concrete.* Engineers have said that such fragments decrease the workability and consequently that more water is required to mix the concrete with corresponding deleterious effects. The further claim has been made that the flat fragments will lie on the surface of the concrete in a horizontal position and that later on they will be broken up by traffic and displaced. In our own laboratory we have made investigations of this subject making use of slabs 3 feet by 6 feet finished in the manner called for in practice.[4] *As the result of these experiments, we have found that the question of gradation of the coarse aggregate has a far more important bearing on the difficulty of finishing than the presence of flat and elongated pieces. When the aggregate is properly graded, the presence of even as much as 15 per cent of flat pieces does no harm, either in the workability of the concrete, the surface finish obtained or in the strength of the concrete. Furthermore, observation of roads built with aggregate containing a rather high percentage of flat and elongated fragments (more than 15 per cent) has revealed no deleterious effects appearing on the surface.* This is well borne out by an observation of the presence and position of the flat fragments as they occur in concrete slabs which have been broken apart. *These fragments do not lie horizontally and near the surface but they are distributed in all directions throughout the concrete mass. My conclusion is that with properly graded aggregate, flat fragments up to as high as 15 per cent of the weight of the aggregate will do no harm.*

If flat fragments occur in aggregate for use in bituminous concrete, I am inclined to believe that they may be detrimental because in rolling them they are apt to rock and, furthermore, when they do occur on

[4] See May, 1930, *The Crushed Stone Journal.*

the surface in a horizontal position, which seems to be rare, they are apt to be broken and displaced, though the same phenomenon does not occur in Portland cement concrete.

J. Stone Sand as a Fine Aggregate in Concrete

There are portions of the country where it pays to manufacture and sell stone sand and this material when properly prepared and properly graded makes a most excellent fine aggregate. It differs from natural sand in that the grains are somewhat sharper and more angular. For this reason it is highly desirable that particular attention be paid to its gradation. *Stone sand seems to be particularly good in creating high beam strength in concrete and therefore it makes a desirable fine aggregate for concrete highways.* There are certain notable examples where this material has been used with very great success. An outstanding example is the stadium of the Ohio State University at Columbus, Ohio, which is withstanding severe exposure conditions remarkably well. A notable example of a structure now being built with stone sand is the Henley Street Bridge at Knoxville, Tennessee, which will be described to you in detail at this meeting. Here, dolomite sand is being used and the concrete is prepared in a central mixing plant.

One of the questions which seems to be important is that of gradation to promote the proper workability. Although our own investigations on this subject have not progressed far enough to enable me to say with any great certainty what is the best gradation, I can, however, give you my best opinion on the subject in the light of our present information and I would suggest that the following gradations should prove to be workable and economical.

	Approximate Bags of Cement Per Cu. Yd.	
	4.5 per cent	6.0, or over, per cent
Passing No. 4	100	100
" No. 8	85	80
" No. 16	70	60
" No. 30	52	40
" No. 50	27	20
" No. 100	5	3
Fineness modulus =	2.6	3.0

When rich mixtures of concrete are used, no doubt the gradation may be made coarser and also the less slabby the particles, the coarser the sand may be. Investigations have not been completed on stone sand to determine the most favorable gradation and, indeed, the same statement may be made with regard to natural sand. But it is believed that the above gradations may be used with confidence.

Stone sand should be permitted to have more material lost by the decantation test than is the case with natural sand because stone dust is a far more durable material than clay which occurs in natural sand and this dust is beneficial in creating higher workability and in holding the water more uniformly distributed throughout the concrete mass. Any perfectly clean, coarse sand, free of fine material permits the water to migrate and renders the concrete non-uniform in its characteristics. Engineers do not seem to realize the value which stone dust has in this respect.

K. The Inherent Stability of Crushed Stone

Although road builders and railroad maintenance engineers have long realized that the angularity of crushed stone is of very distinct advantage in rendering layers of crushed stone stable and resistant to motion under the action of traffic, there is scant information on the numerical relationship between the stability of stone as compared with more rounded material, such as gravel. We have recently completed a series of tests which demonstrate in a striking manner that a layer of crushed stone will support at least double the load which will be supported by rounded gravel. The conclusions drawn from this investigation, which has been conducted in the laboratory of the National Crushed Stone Association, are as follows:

1. The use of approximately 51 per cent of fine crushed stone ¾ to No. 4 in size considerably increases the stability of ¾ to 2½ in. crushed ballast.

2. The crushed stone composed of angular fragments possesses far greater stability than the gravel composed of rounded fragments.

3. The inclusion of crushed fragments in gravel ballast increases its stability over that which obtains when merely rounded fragments are used. However, the stability, even when 49 per cent of crushed fragments is present, is considerably less than that obtained with crushed stone. The maximum bearing value of the gravel ballast is something under one-half that of the crushed stone ballast and is reached with very little movement of the bearing block.

It is believed that these tests give an excellent idea of the numerical relationship between the stability to be expected from these two respective materials. Not only do the tests apply to railroad ballast but they apply also to highway construction where the macadam or the bituminous type of road is used. Unquestionably, the inherent stability of the aggregate is largely responsible for the stability of the bituminous pavement and anything which might be done to improve the stability of the coarse aggregate or fine aggregate is of advantage to the stability of the pavement. Consequently it can be asserted with confidence that crushed angular aggregate is much to be preferred for use in bituminous pavements than material of a rounded nature. The tests are well borne out in practice but they are valuable in showing, numerically, the relationship of the relative load carrying capacity of various gradations and types of materials.

The field for the use of crushed stone is large and many more facts could be discussed with profit, if time would permit. Let me emphasize with you the value of making use of new facts as they are developed and of studying these facts so they will be a part of your sales knowledge. We are told that knowledge is

(*Continued on page 20*)

Stabilization of the Highway Program[1]

By CHARLES M. UPHAM
Engineer-Director, American
Road Builders' Association

♦ It is becoming increasingly apparent that there is a growing tendency to severely curtail highway appropriations on a basis of effecting economies in governmental expenditures. There is much to be said at the present time in favor of continuing with an adequate construction program and the following article by Mr. Upham brings out some interesting thoughts bearing on this subject.

Trend of Highway Activity

WHY should there be any need for highway stabilization at the present time? Since 1919 there has been an increase, varying from ten to twenty per cent each year, in the amount of money going into the total highway program. In 1930, the upward trend halted and the ascending line flattened. In 1931, due to extra effort put forth, the additional federal aid and emergency funds for unemployment highway expenditures were sustained at a nearly normal level.

Due to the fact that only eight legislatures are in session this year, and that most of the programs were formulated at last year's legislative sessions, there is little chance of much legislative interference in 1932, as far as state highway programs are concerned. The questionnaires sent out by the American Road Builders' Association to states show the estimated budgets are only eighty million dollars less for 1932 than for 1931. Questionnaires from about 200 cities indicate the amount of money to be spent in 1932 will approximately be the same as in 1931. The counties, however, show quite a decrease and taking into consideration the counties contacted with, the same proportion holding true over the whole of the United States, there will be a drop of two or three hundred million dollars in the county program.

A large percentage of states have legislatures meeting in 1933 and with a demand for lower taxes and in many localities a highway holiday, if we are not careful and do not work together on this program, we are going to get into such a tail spin in 1933 that we will constantly refer to the boom period of 1931.

We should analyze the facts at this time, taking into consideration all factors contributing to highway expansion in the past to determine whether these factors are still effective and the action necessary to avoid curtailing our highway program.

The trend line of highway expenditures was steadily upward for 10 years. All upward trends are broken sooner or later and this has proven to be no exception. Whether this is just a hesitation or the start of a definite down trend possibly depends on the elimination of adverse factors which are now tending to curtail highway activity.

Most manufacturers, some material producers, and the equipment plants expanded their business and prepared for business on a continued upward scale just as though the trend of activity would continue upward forever. Now it has leveled off with a possibility of descending. We hope we can keep it level. We hope it won't go down; we would like to see it continue upward. But at the present time the industry is suffering from over-expansion. The 10 to 15 per cent annual increase in expenditures has ceased. Anticipated business has not materialized, forces have been cut and losses have been sustained. Reorganization has been necessary to adjust production to a decreasing demand.

In past years the manufacturers of machinery could export their surplus equipment to other countries. The conditions in foreign countries are even worse than here so this offers no source of relief at the present time.

We have had a decade of expanding highway activity. Funds have increased rapidly and this factor has been responsible for a great deal of construction which can not be justified. This is one of the conditions that must be corrected at the present time in order to get back again upon a sound basis, and continue on it.

Causes for Interruption

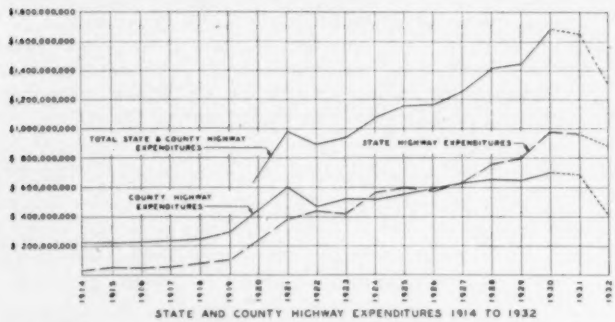
The Governor of New Jersey proposes diverting $16,000,000 from highways. He justifies this by saying it will have little effect upon unemployment, because practically all the highway work is done by machinery. In other words, with one sweep of his hand he throws away sound economic laws, with the mistaken idea that the unemployment situation is not affected by highway construction due to the fact that machinery eliminates the laborer. He doesn't consider the large number of men being kept employed by machinery plants, transportation companies and material dealers and how this will throw out a large number of men now occupied in addition to those already out at the present time. Such action has a far reaching effect.

The clamor for good roads at the present time is being submerged by a clamor for the reduction of taxes. Some of this is caused by dissatisfaction resulting from the present methods of distributing highway funds. Most of the trouble can be traced to a desire to cut expenses, regardless of results and without consideration for the causes underlying the present economic stringency.

[1] Presented at the Fifteenth Annual Convention of the National Crushed Stone Association, Pittsburgh, Pa., Jan. 19-22, 1932.

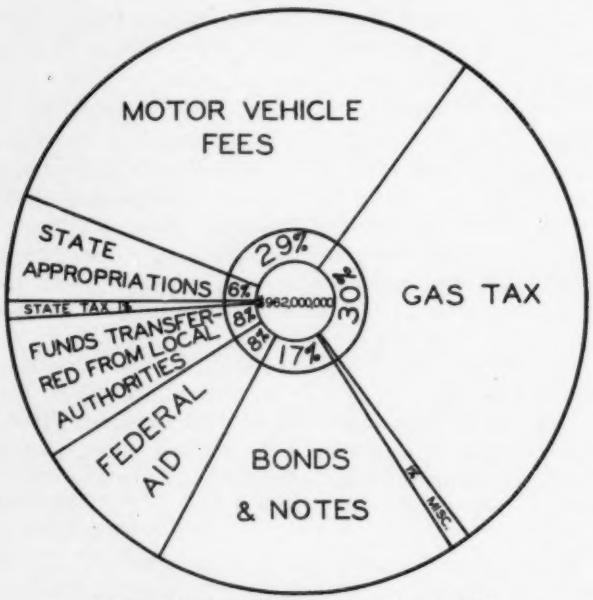
Gas Tax Diversion

And so from many sources, principally in the counties, and now being taken up by many of the states, comes this demand that there shall be an interruption in the highway program—a cessation of the building and maintenance of roads. In order to satisfy this


TOTAL STATE & COUNTY HIGHWAY EXPENDITURES
STATE HIGHWAY EXPENDITURES
COUNTY HIGHWAY EXPENDITURES
STATE AND COUNTY HIGHWAY EXPENDITURES 1914 TO 1932

State and County Highway Expenditures, 1914 to 1932

demand for reduction in taxes, the gasoline tax which was created for road building purposes, must be diverted to other activity. At the present time, nine states are diverting the gasoline tax from highways to projects ranging from the building of sea walls to the buying of text books, from the building of forts to the propagation of oysters—things for which the gasoline tax was not intended at all. These are the things that are going to raise havoc with the gas tax.

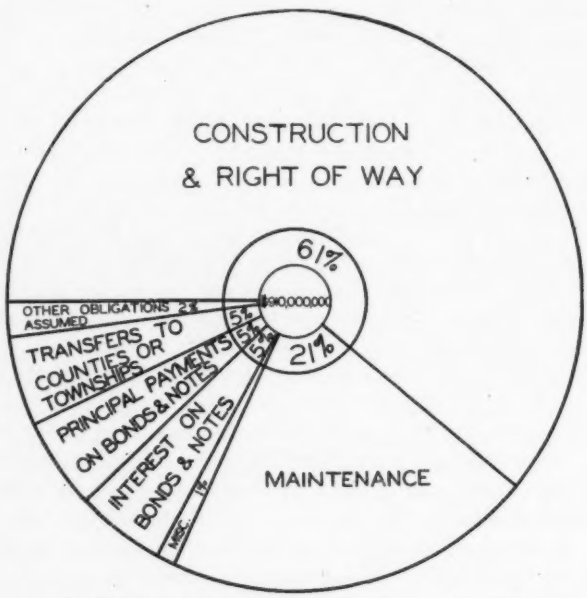


Source of State Highway Income for 1929

There are forty-one states at the present time allocating the gasoline tax to the counties, and sixteen of these states have no jurisdiction whatever over the expenditure of these funds. In some cases the counties are using them for purposes absolutely outside of the field of road construction and maintenance. They are building institutions, putting them into the general tax fund, using them as a replacement tax, paying off old bonds, and similar things. That money which is a highway tax should be conserved for use on highways if we are going to continue even on our present basis.

Need for Highways

The question is, should there be an interruption of the highway program? At the present time there are about 3,200,000 miles of highways in the United States; 700,000 miles have been improved; these are the roads we ride over—concrete, macadam, asphalt, brick, and so forth—leaving 2,500,000 miles which we still call mud roads. Those are the roads on which we can



Distribution of State Highway Funds for 1929

center a great deal of attention. But, if we consider only 2 per cent of this annually, that would give us a program of 50,000 miles a year which we should improve to some extent.

It has been the practice for the past few years to add approximately 15,000 miles of hard surface road each year. Assuming this figure as the normal amount, we can add that 15,000 miles to the 50,000 making a normal demand or normal road construction of 65,000 miles per year. Of the 700,000 miles of road already improved, most of it has an average life of not more than twenty-years, which means that 5 per cent should be replaced every year. That in itself is 35,000 miles, so we get a normal program of 100,000 miles per year, which is more miles of highways than we have as yet built in any one year.

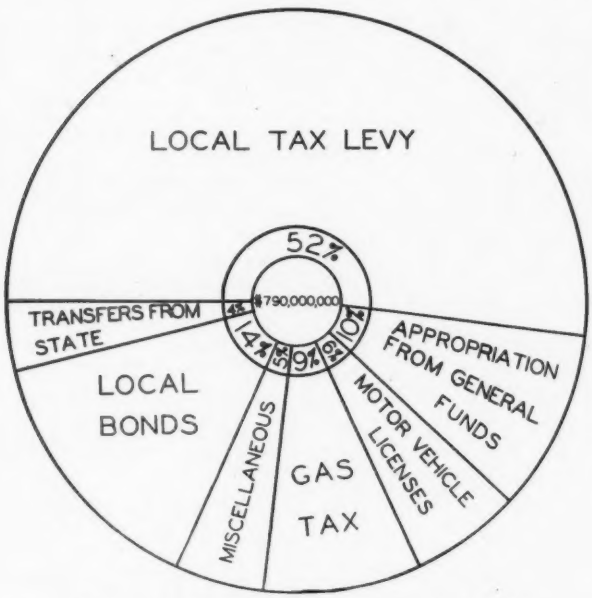
We are therefore not overproduced and there is a demand for more road construction, to say nothing about the belt lines around cities which require a great deal of road construction, and does not give considera-

tion to the widening which at the present time forms a big part of the work of every highway department. At the present time there is no over-building in highways and we still need to go forward in highway construction.

In our study of economics, it has been repeatedly proven time and time again, that a highway properly located, properly constructed and type selected according to the best practice pays better dividends than any other investment. It adds to the wealth of the community and the country, and from the standpoint of economics, it is one of our soundest investments.

Unemployment

In addition to this, there is the subject of unemployment. The large number of men who were employed on highways this last year ran to at least one million,

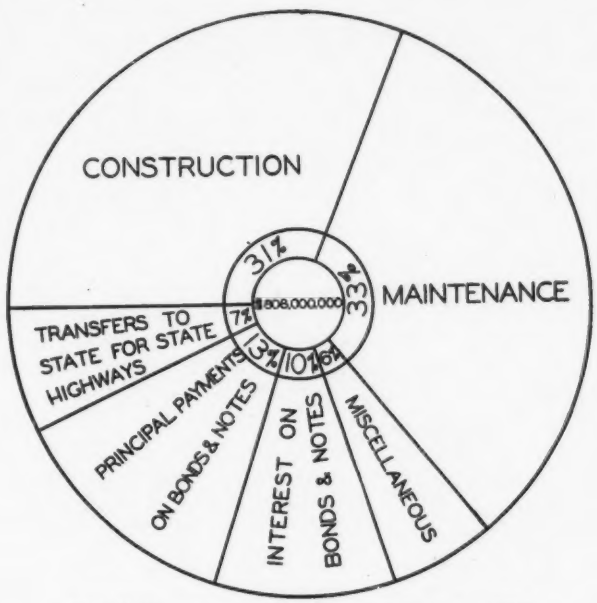


Source of Local Highway Income for 1929

all working on state, federal and county construction, and that meant, from the best observations that could be made by the United States Bureau of Public Roads that for each man directly employed on the highway, two other men were working back of the lines in some way, either at the mines or in the foundries, the machine shops or the transportation companies. It is therefore estimated that three million men were working on the state, county, city and federal programs during the past year, and it was conclusively shown that the highway program was probably the best means we had of putting these people to work. A man who has been trained to work in any line, whether he has been an operating engineer or a clerk in a store, or whatever vocation he may have followed, can find a position in the highway construction field where he can work in an efficient manner.

Features Developed at A. R. B. A. Convention

If we consider the interest and enthusiasm shown at the Road Builders' Convention at Detroit as any indication, we can look forward to a prosperous year, or at least an active year. We registered 2,000 more



Distribution of Local Highway Funds for 1929

people in Detroit than we did a year ago. Our building there was filled with exhibits, and the meeting was a success in every way.

We had some fifty meetings on the various details and subjects connected with highway construction, maintenance and operation and out of that entire assemblage, came two major features, and one minor feature of almost equal importance.

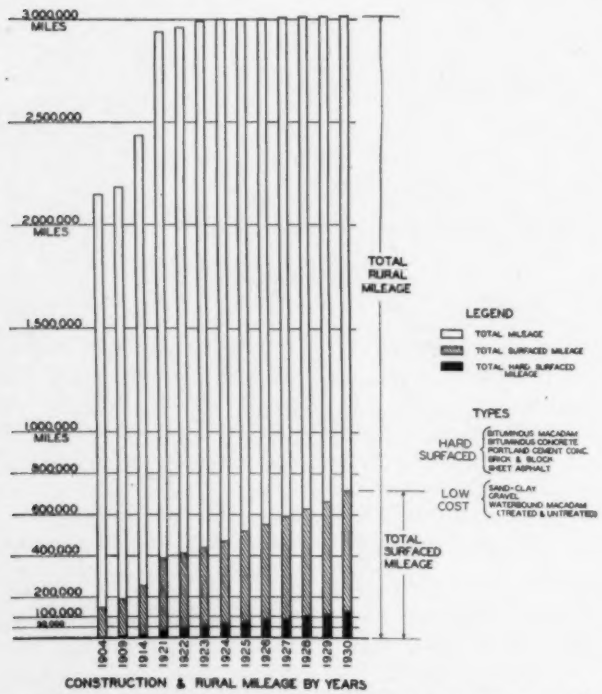
The first major feature was that there absolutely should not be any interruption to the highway program at the present time.

The highway program has held its own during the past year. It has been carrying the brunt of construction, as we know. The building of school houses, public buildings, and homes, has fallen off, but the highway program has held up. It has been the backbone of industry. If we do not protect the backbone during this next year, both in the legislatures and among the officials, we are going to find that an industry with a broken backbone is worthless.

Who pays for the highways? According to the 1929 figures on state construction the user is paying an increasing percentage of the cost of highways. Between 75 and 90 per cent is derived from the gasoline tax and automobile license revenue or from bond issues predicated upon these taxes. General property taxes account for less than 10 per cent and most of that is from funds transferred from counties. Eight per cent is derived from Federal Aid.

The next question is the gasoline tax. This tax is the most important source of highway funds and should be used entirely for highway purposes. It should not be diverted for any other uses than the construction and maintenance of highways.

This subject was treated most satisfactorily by Mr. Fred Everett, President of the American Association of State Highway Officials in an address at Detroit.



Total State and Local Highway Mileage Construction by Types from 1904 to 1930

He told how the gasoline tax was first authorized for the completion and extension of highways, and how it should be held inviolate for purposes of road construction.

The Advisory Conference

The American Road Builders' Association is going to start on the promotion of highway programs again. It is going to continue its technical work, but it is going to add to that the promotion of highway programs, just as we did several years ago.

At a publicity Conference in Detroit held in connection with the Road Builders' Convention, it was brought out by the newspaper editors that the public is not absolutely sold on good roads, that there is growing up in different cities and counties, especially —not so much in the states—a feeling that there should be a highway holiday, that the highway work should be deferred.

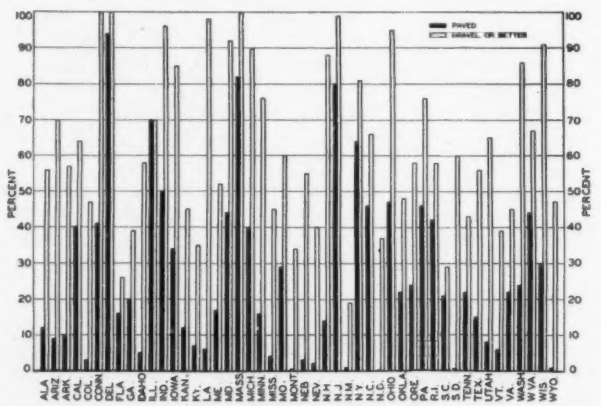
The American Road Builders' Association has joined with The National Crushed Stone Association and eighteen others in "The Advisory Conference on Highway Stabilization." The Advisory Conference is made up of organizations interested in the promotion of the highway program. It includes the Grange, the A. A. A., Rural Letter Carriers, the Sand and Gravel Association, and similar organizations.

The Associations are represented by one or two members at each meeting. The purpose of the conference is to discuss features which are adversely affecting highway expansion with the idea of correcting them.

The first Conference decided that it would select for its subject the diversion of the gasoline tax. All the information on the subject will be secured, presented to the conference, discussed, rewritten, and then after adoption by the conference returned to the individual organizations for distribution.

The information is then sent out to all those interested in the highway program, and particularly to the legislatures. There will be forty-four legislatures meeting in 1933, and it is going to be up to every one of us to show why there should be no interruption of the highway program, to show the far-reaching effect it will have upon the highway industry. We must show that there should be no diversion of the gasoline tax, that it must be used entirely for road and street construction and maintenance.

Concerning the question of hand labor versus machinery, the states should not go wild in trying to



Status of State Highway Construction by States, Jan., 1930

substitute hand labor for equipment, to the extent that some of them are now doing. Many have resorted to hand labor when it is absolutely inefficient. In some cases, it has been shown that excavations that could have been made at a cost of twelve, fifteen, or twenty cents, have cost a dollar, and sometimes as high as $1.20 when done by hand labor.

That is not the way to correct an uneconomic condition. In other words, such a condition cannot be remedied by doing things inefficiently or uneconomically.

« « EDITORIAL » »

Mr. Salesman, Know Your Product

IT SEEMS to us that broadly speaking salesmen can be divided into two categories: First, those who have full and complete information with regard to the product which they are selling; and second, those whose tongues may be glib but whose knowledge is only superficial. Both types must necessarily exist in every industry and it would seem from our limited observation that in much too high a percentage of cases the salesman strongly relies upon his glib tongue and perhaps pleasing personality and discounts the necessity and advantage of having accurate and comprehensive information. Though perhaps not so recognizable, these brief comments are intended as a plea to the salesmen of the crushed stone industry to learn more of the product which they are endeavoring to sell.

A friend of ours not so long ago enjoyed an interesting but somewhat disappointing experience. It seems that he considered that he was in the market to purchase a new automobile. He therefore got in touch with a salesman who handled the make of car in which he was particularly interested. The numerous advantages enjoyed by this particular car were told him in considerable detail and with such appeal that he was practically convinced that he would make no mistake in purchasing the car in question. A few days later, when driving in a different part of the city, he discovered that he was passing another agency for the same automobile and more out of curiosity than anything else he stopped to interview one of the salesmen of this agency. He asked a number of questions, such as the capacity of the radiator, the quantity of oil required for one filling, the gasoline mileage which might reasonably be expected, total weight and a few other similar questions, all of which were very simple to answer and in fact were specifically answered in the printed specifications of the car. You can therefore imagine his amazement when Salesman B gave him information which in no particular was the same as that given by Salesman A. This experience aroused his interest to the extent that he then made it a point to call at two or three other agencies for the same automobile and present the same questions. To make a long story short, out of the four or five agencies interviewed two were in comparatively close agreement in the answers, whereas the other three varied very much more than might reasonably have been expected. Now, of course, the fact that these salesmen did not agree in their descriptions of the car in question in no sense altered the value of the product, but it did destroy the confidence of our friend in the reliability of the various agencies interviewed. It is not to be thought for a minute that any one of these salesmen was deliberately giving out misinformation. They do stand condemned, however, for mental laziness because the information requested was at their very elbows in the printed descriptive literature of this particular automobile. With but a negligible amount of time spent in preliminary preparation, one of these gentlemen would have made a sale.

The salesmen of the crushed stone industry have frequently raised the cry that they would welcome additional facts and information with regard to the merits of crushed stone. It has often been stressed that such information should be prepared in as non-technical a manner as possible. At the Fifteenth Annual Convention of the National Crushed Stone Association held in Pittsburgh the latter part of January, an effort was made to answer this request of the salesmen. We feel that the article which Mr. Goldbeck, Director of our Bureau of Engineering, presented at the convention, which appears in this issue of *The Crushed Stone Journal*, is one of the most interesting and valuable which he has yet written. Over the last few years some excellent information has been developed in the Association's research laboratory with regard to the merits of crushed stone and much has been correlated from other sources. The more important developments in this regard are to be found in this article expressed in language which is clear and concise and stripped of as much of the technical as is practicable. We know of no single source where the crushed stone salesman can obtain as much really helpful information as from a careful and thoughtful study of this article.

A very real effort has been made by the Association to compile for the salesmen of the industry a digest of information relating to crushed stone which should be of distinct value in promoting sales, and if this information is to serve the purpose for which it was intended, the salesmen should give the necessary time and thought to completely familiarizing themselves with these "Facts for the Crushed Stone Salesman."

John E. Weber

THE many friends and acquaintances of Capt. John E. Weber, for thirty years Secretary of the Casper Stolle Quarry and Contracting Co. of East St. Louis, Illinois, will be deeply grieved to learn of his sudden death, which took place about midnight on Saturday, February 13, at his residence, 5814 Bartmer Avenue, St. Louis, Missouri. Capt. Weber had long been an active and prominent member of the crushed stone

industry and his loss will be especially felt by the members of the St. Louis Quarrymen's Association, with which he has been identified for a great many years. Our deep and heartfelt sympathy is extended to his family and business associates in their bereavement.

We are indebted for the following particulars regarding his life to an article appearing in a local St. Louis newspaper.

"Capt. Weber was 65 years of age. He was born at Seventh and Locust Streets, then a fashionable residence district, where the town home of Henry Shaw was located. His mother was a member of the Salisbury family, after which Salisbury Street and the town of Salisbury, in this state, were named.

"Capt. Weber is survived by his widow and mother and by two sisters, Dr. Caroline Weber of Santa Rosa, California, and Mrs. Louise E. Frost, of Springfield, Illinois. Aside from being widely known in the construction and quarry industry, Capt. Weber had an extensive acquaintance in the older generation of army men. He was a lieutenant in the famous Battery A, the St. Louis artillery organization that had active service in the Spanish War in Porto Rico, a battery of which many St. Louis men of prominence were members.

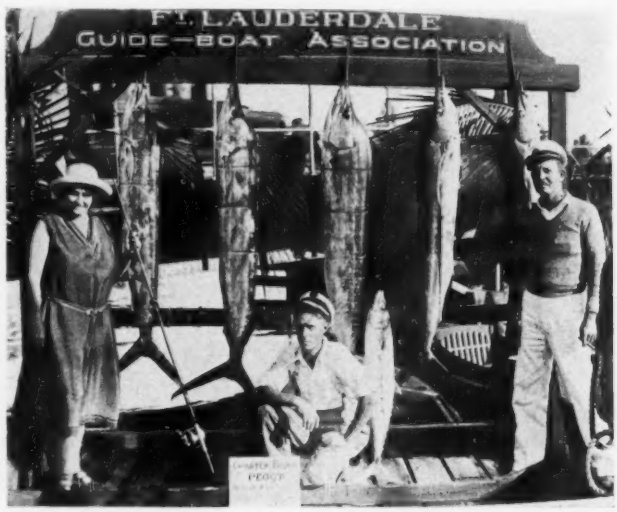
"At the conclusion of the Spanish War, when it became necessary to have an army of occupation in the Philippines, Lieut. Weber secured an assignment of service in the islands and proceeded at once to Manila. He remained in the Philippine army in active service for about two years, reaching the rank of captain. Upon returning to the United States and civilian life he made a connection with the Casper Stolle Quarry and Contracting Company, continuing without interruption until his death."

An Important Announcement

BECAUSE of the fact that anticipated income for the current year is not coming up to expectations, a special meeting of the Executive Committee of the Association was held in New York City on April 1, 1932, primarily for the purpose of giving further study to the proposed budget for the present year and making such curtailment in expenses as seemed necessary under the circumstances. Of interest to the readers of *The Crushed Stone Journal* will be the decision of the Executive Committee to have the *Journal* published throughout the remainder of the year only in alternate months, or instead of the customary twelve issues, there will be but seven. It will be noted that this change has been effected with the present issue which is designated as the March-April number. Subsequent issues will be designated May-June, July-August, September-October and November-December. It is, of course, regrettable that it has been necessary to take this step, but under present conditions it seemed to be the wisest course to follow. Other means for decreasing our expenditures for the present year were also determined upon and will be made known to the membership at a later date.

Mrs. Evans Makes World Record Sailfish Catch

THE crushed stone industry has long been familiar with the name of Grace M. Evans, President of the Monon Crushed Stone Co. of Monon, Indiana, who, since the death of her husband fifteen years ago, has actively directed the operations of the company, and in a manner which has brought forth the well-merited praise of her friends and business acquaintances throughout the industry. Mrs. Evans has recently demonstrated that she is not only able to compete with mere man in a business way, but has now invaded one of his favorite sports, establishing a record which will tax the skill of many before it is set aside.



Mrs. Grace Evans with her world record catch of five sailfish made near the Gulf stream, between Hollywood and Fort Lauderdale, in 2½ hours

Mrs. Evans, who spends her vacations in Hollywood, Florida, was recently cruising in the Gulf stream near Hollywood when she hooked several sailfish and landed five of them in a period of two and one-hour hours. The largest fish was over seven feet long and weighed 53¼ pounds, while the others varied in weight between 50 and 35 pounds. The sailfish is generally conceded to be one of the hardest fighters that swims, and most anglers are delighted if they catch one in a day's fishing. To accomplish such a remarkable feat requires skill and stamina unusual in the fairer sex and Mrs. Evans is to be most heartily congratulated upon setting a record by her amazing accomplishment.

« « Manufacturers' Division—New Equipment Section » »

Exhibitors' Committee Industrial and Power Shows, Inc., Elects Officers

At the annual meeting of the Board of Directors of the Exhibitors' Committee Industrial and Power Shows, Inc., held December 3rd, 1931, the following officers were elected for 1932: President, C. F. Radley, Publicity Director of Oakite Products, Inc., New York City; Vice-President, Victor Wichum, C. J. Tagliabue Mfg. Co., Boston; Secretary, G. S. Carrick, American Arch Company, New York City; Treasurer, J. P. Ferguson, Reading Steel Casting Company, Bridgeport, Conn.

The Exhibitors' Committee Industrial and Power Shows, Inc., established in 1926, is a non-profit organization of manufacturers interested in the improvement of conditions relating to industrial exhibitions. It maintains contacts with the management of a wide variety of industrial exhibitions and shows, and has the cooperation of the Chamber of Commerce of the United States.

Among the Directors who will preside over the twelve industrial groups of the Executive Committee next year are: L. W. Shugg, Ass't Mgr., Convention and Exhibits Department, General Electric Company, Schenectady, N. Y.; H. S. Wheller, Vice-President, L. J. Wing Manufacturing Corporation, New York City; S. G. Bradford, Secretary, Edge Moor Iron Company, Edge Moor, Delaware; F. C. Eibel, Publicity Director, Worthington Pump and Manufacturing Company, Harrison, N. J.; R. H. Bacon, Publicity Manager, Fairbanks, Morse & Company, Inc., Chicago, Ill.; W. W. Bertram, Sales Manager, Morse Chain Company, New York City; L. F. Gordon, General Manager, Southern Power Journal, Atlanta, Ga.; J. P. Ferguson, Sales Engineer, Reading Steel Casting Company, Bridgeport, Conn.; G. S. Carrick, Manager, Industrial Department, American Arch Company, New York City; E. J. Billings, Executive Ass't, Babcock & Wilcox Company, New York City; Victor Wichum, Chief Engineer, C. J. Tagliabue Mfg. Co., Boston, Mass.; C. F. Radley, Director of Publicity, Oakite Products, Inc., New York City.

Information concerning proposed industrial exhibitions is compiled and assembled into status reports at the permanent office of the Exhibitors' Committee, maintained at 403 Graybar Building, New York City. Copies of these status reports are sent to all members. Special investigations and reports are made concerning proposed exhibitions, enabling members to judge more accurately the value of participation in them. The Committee also assists and advises members in adjusting complaints, and correcting undesirable conditions in connection with exhibition matters. Plans for 1932 include a survey of over 200 industrial exhibitions, in addition to activities effecting improvement in exhibits and attendance.

Custom Built Vibrator Screen

In announcing a new Vibrator Screen, Stephens-Adamson Mfg. Co. of Aurora, Illinois, emphasizes the fact that each screen is built with a vibrating unit assembled to suit the material handled.

A series of several hundred efficiency tests proved the very definite relationship between the nature and size of material to be screened and the amplitude, frequency and angle of vibration. The new S-A screen was built as a result of these tests and has several unique features which are claimed to increase screening capacity, decrease maintenance costs and reduce leakage of vibration to building supports.

The screen is of the positive vibration type, in which a rigid screen body with one or more decks is given a vibration of fixed amplitude by the rapid "throw" of an eccentric shaft. There are three units—screen body, vibrating mechanism and subframe.

The vibrating mechanism is a self-contained, factory adjusted unit. It consists of an eccentric shaft, adjustable balance wheels, heavy SKF, double row bearings, grease seals and a rigid tubular housing. In recommending screens, the engineers require definite data on materials, sieve analysis, capacities and characteristics. From these, the vibrating unit and drive are assembled to give the vibration frequency and amplitude which will prevent blinding on one hand or excessive bouncing on the other.

Several other new features have been built into the screen, chief of which are quick-change screen panels and a stabilizer mounting.

The new quick-change panel is a full size piece of screen cloth with a stiff cross angle brazed to each end. The panel is placed by sliding it up the tubular deck supports until the ends of the upper cross angle drop into sockets in side frames. Stretching levers are slipped on the ends of lower angle and tightened. Timed tests indicate that two men can change or reverse a panel on either an upper or lower deck in about fifteen minutes.

The stabilizer unit, made up of parallel arms, holds the screen body at the desired screening angle without the use of corner balancing springs or bumpers. The unit connects screen body and subframe in such a way that the screen is free to vibrate and yet is held at a given angle. It is claimed that the elimination of bumper springs reduces subframe vibration considerably. An additional advantage claimed for the stabilizer is that by loosening two bolts, the operator can tilt screen body clear of chutes for making panel changes or change screening angle to increase screening efficiency for different volumes of material.

Fred A. Gill Joins Armstrong Organization

His many friends and acquaintances throughout the crushed stone industry note with interest that Fred A. Gill, formerly with the Gill Rock Drill Co., Lebanon, Pa., is now associated with the Armstrong Mfg. Co. of Waterloo, Iowa. Mr. Gill has been prominently identified with the quarrying and mining industry for a number of years and has been active in the development of the stone and cement industries throughout the United States and Canada and many sections of South and Central America. Mr. Gill has established an enviable reputation because of his ability to successfully analyze and cope with difficult drilling problems in mines and quarries. He is considered an expert on blast hole drilling with churn type drills. His headquarters will be at the Eastern Office of the Armstrong Mfg. Co., 1506 Mayflower St., Harrisburg, Pa.

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JAW PLATES — DIPPER FRONTS
MANTLES — PUMP PARTS

Double Their Life By Welding with TIMANG

(AIR TOUGHENING)

WELDING ROD

"TIMANG" Trade Mark is registered in United States and foreign countries. "TIMANG" Steel is protected by U. S. Patent 1,732,202 and foreign patents. Other patents pending.

WEARING parts built-up or welded with TIMANG (air toughening) Welding Rod give equal or better service than the original part.

Welds made with TIMANG possess the same hardness, the same resistance to wear as cast 12% manganese steel. In addition, the TIMANG weld possesses unusual ductility and will not crack in service.

You can double the life of manganese steel wearing parts, as well as carbon steel castings and forgings, by insisting that TIMANG be used on every welding job. If you are not now using it, send for full particulars today.

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New German Gritting Machine Saves Time in Building Roads

ACCORDING to a Berlin correspondent, road repair work in Germany will be speeded up considerably by the introduction of a new machine which has just been tested with satisfactory results in Augsburg, Bavaria. It can cover a section of road 350 meters (about 1,000 feet) long and five meters wide with a coating of chippings in less than 10 minutes, or 12 times faster than it hitherto has been possible.

The surface of many important German cross-country roads consists of a layer of tar into which chippings are stamped. In renewing this surface modern tar spraying machines are now being used which can lay a tar cover across 1,750 square meters of road surface, corresponding to a length of 350 meters and a width of five meters, in about six minutes.

But this speed has been of little use in the past, as the chippings strewing device could not follow as quickly. To cover the same amount of surface with chippings, about 18 cubic meters of material are needed. A chipping-strewing machine capable of carrying three cubic meters at a time would have to return to the base and be refilled six times, needing two hours for the process, as compared with six minutes used by the tar sprayer, to complete its part of the work.

The characteristic feature of the new machine is the fact that it no longer carries the chippings itself, these being piled along the roadside. The machine possesses a drum at its front end in which elastic brushes rotate. While the machine moves along the road's edge, the brushes pick up the chippings and throw them fountain like to the side across the road. Those chippings reaching the farther side of the road attain a height of three meters. They fall with such force into the soft tar that they bury themselves deeply.

When this new strewer was tried out near Nurenberg a road section measuring 360 by 5 meters was tarred and strewn with chippings in less than ten minutes and soon after traffic could pass again.—From Feb. 1932, issue of *Good Roads*, an English publication.

(*Continued from page 12*)

power; certainly we know it to be very useful when properly assembled and used for the purpose at hand.

Too frequently, real facts do not exist and it is one of the functions of our research department to develop the necessary information which will help you to make your sales. You can help us by telling us what to investigate for your benefit and we will do our part in determining the real facts of the case. We shall greatly welcome your suggestions and we in turn will cooperate with you to the fullest in helping you with your sales problems.

Work on Highways is Well Maintained

EMPLOYMENT on road building and the awarding of contracts for highway construction continued at a high level in December, according to a statement as of February 2 by the President's Organization on Unemployment Relief.

New highway contract letting throughout the country continued at a high level in December, according to a statement by W. C. Markham, executive secretary of the American Association of State Highway Officials, received by Fred C. Croxton, Assistant Director of the President's Organization on Unemployment Relief.

"Reports from 35 State Highway Departments show that in December contracts for 3,119 miles of State and Federal-aid motor roads were let at an aggregate cost of $30,012,128 to be expended in this work. This sum includes $4,612,100 for bridges. Of the 17 States which reported contracts both for November and December, the total in November involved 2,193 miles at $26,971,554 and in December 1,852 miles at $23,197,-709. This represents a decline of about 15 per cent both for mileage and dollar volume of new highway contracts in December as compared with November, which is considered a good showing for this season of the year. Wisconsin led all other States in December contracts and Illinois was second.

"Highway employment among 25 States which reported on this item was 162,461 in November against 133,026 in December. The decline of 18 per cent is not excessive for the winter season. Work is continuing at an unusually high level because of the mild weather. Continued contracting for new work insures an expansion of employment in the spring. In December, Pennsylvania led for highway employment with 26,489 persons at work and Michigan was a close second with 20,267."

Federal Road Work is Well Distributed

"THE POLICY of the Federal Government in distributing Federal Aid funds so that the less populous and less wealthy states can also make noteworthy progress is in keeping with the spirit of the federation of states."

This statement was recently made by Frederic E. Everett, president of the American Association of State Highway Officials, in commenting on the need for continued Federal Aid in road building.

Mr. Everett further said: "Before anyone criticises the present method of distributing Federal road funds let him first consider the principles of the constitution, the character of the country and the country's needs. The secret of the strength of the United

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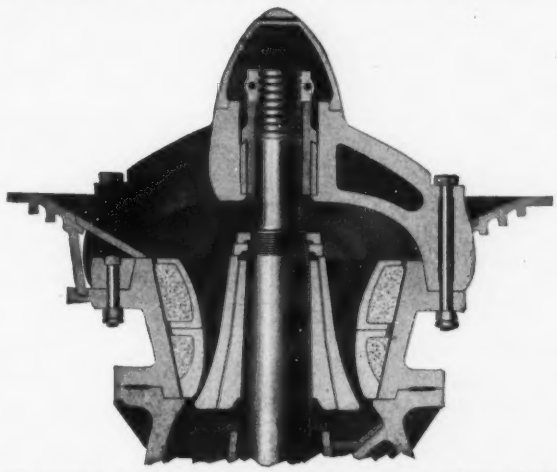
GREATER OUTPUT
From Your Old Style
Gyratory Crusher
With Our New Patented
BELL HEAD & CONCAVES
Same POWER!—Finer Product!



IF YOU ARE NOW USING TWO CRUSHERS TO SECURE YOUR OUTPUT OF SMALL SIZES YOU CAN SHUT ONE DOWN AND SAVE THE DIFFERENCE!

ONE EASTERN PRODUCER HAS FOURTEEN CRUSHERS WITH BELL HEADS AND CONCAVES

A No. 6 McCully formerly made 50 tons to 2"—now 101 tons to 1¾"
A No. 8 K Gates—old capacity 98 tons to 2¾"—now delivers 205 tons to 2½"
A 14" Superior McCully formerly delivered 60 tons to 2½"—now working part time, 70 tons to 1¾"

USERS SAY:—
"****Its performance is a revelation****"
"****We cannot do without it****"

YOU, TOO, MAY BENEFIT!
Write for Bulletin No. 1110

In connection with certain types of non-choking crushers, we call the attention of the public to our patent 1,837,102, issued December 15, 1931, relating to crushers of this type. We intend to enforce our rights under said patent against all manufacturers and users of stone crushers containing the features covered by said patent and to prosecute all infringers of said patent.

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EXPORT DEPARTMENT—104 Pearl Street, New York City

States lies in that word 'united.' It is the duty of the country as a whole to develop and guard its natural resources. The western states, for example, with their large public domain areas contain potential wealth of staggering volumes. It is a national responsibility to see that the West gets good roads along with other parts of the country.

"State lines mean little nowadays and but for one reason—good transportation. The assistance extended states through Federal Aid has played a major part in this interstate travel drama, a part that has been so successful that any thinking person with true patriotism can readily see that the value of Federal assistance is beyond measuring in dollars and cents.

"It has been said that states like New York, Pennsylvania and Illinois receive too little Federal assistance in comparison with their contributions. No schooling in economics is necessary to perceive the fallacy in that thought. All of the wealthy states are headquarters for large numbers of corporations and individuals who do a nationwide business. They pay income taxes in one state whereas their profits were made in many other states."

States to Stop Gas Tax Evasion

By E. E. DUFFY

WITHOUT the fifes and drums or the blatancy that goes with liquor bootlegging, another form of bootlegging has eaten its way into the public pocketbook. That is the bootlegging of gasoline which, claim the most conservative estimators, steals $40,000,000 yearly from highway funds, enough to build, at present low prices of labor and materials, some 1,500 or 2,000 miles of concrete highway.

That bootlegging of gasoline has existed for some little time has been known, but not until quite recently was it discovered that it has become so widespread that about one-fifteenth of all gasoline used in automobiles is sold in such a way that the prescribed gasoline taxes are not paid to the states.

Several states, when they became aware that many an unsuspecting motorist's dollar was making "successful" business men out of crooks, launched campaigns that have a two-fold purpose; the placement of bootleggers behind the bars and of gasoline tax money in the proper receptacle, the state treasury.

Gasoline bootlegging, which is found in nearly every state regardless of the size of the gasoline tax rate, can be stopped and at a profit. In Illinois, for instance, the 1931 July-October collections were $728,000 more than in 1930, even though less gasoline was sold. Further, 50 tax evaders have been indicted and more will be soon. Pennsylvania is also playing a winning hand. In September, 1931, that state collected one-third more gasoline tax money than in the same month in 1930. Pennsylvania has more than 600 gasoline tax evasion cases pending in the criminal courts.

To curb gasoline tax evasion states must cooperate with each other, and reputable gasoline distributors and dealers must work together even to the extent of forming combative organizations. In some cases it will be necessary for states to tighten up laws. Fraudulent entries in books, the carting of untaxed gasoline across state lines, the operation of dummy companies, all can be eliminated.

At any rate, gasoline bootlegging can be stopped for gasoline can't be manufactured in the quiet of the kitchen or basement. It must come from large sources of supply, which makes it comparatively easy for government and private agencies to call a halt.

An Unusual Inquiry

The Washington Office of the Association has just received a request for a list of companies producing a crushed green material, either granite, marble, limestone or sandstone. It would be appreciated if all companies which can meet this specification would place their names on file with the Secretary in Washington.

You want to know the resources of your bank. Why not inquire about the resources for service and research behind the company that supplies your explosives?

HERCULES POWDER COMPANY
INCORPORATED
973 KING STREET, WILMINGTON, DELAWARE A32-R

REG. U. S. PAT. OFF.

Equip, Say, *Half* Your Vibrating Screens With Double Corrugated Plate

WE SAY "half" in the interests of a fair test. We have every reason to believe that you will get more thorough screening and more life per dollar invested from this screening medium than from any other material.

In writing for prices, give make and size of screen used.

Makers of
Elevator Buckets of All Types
Mitco Interlocked Steel Grating, Mitco Shur-Site Treads and Mitco Armorgrids

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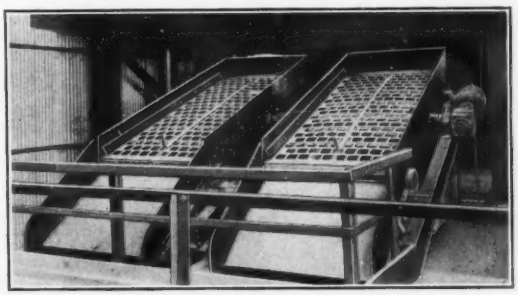
PERFORATED METAL SCREENS

The quality of CROSS Screens gives longer service, increased production and lower cost.

CATALOG ON REQUEST.

BUCKETS, TROUGH, FLIGHTS, CHUTES, ETC.



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CROSS PERFORATED PLATES ON TYPICAL VIBRATING SCREEN INSTALLATION.

Write for details of advantages and cost.

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DIPPERS OF QUALITY

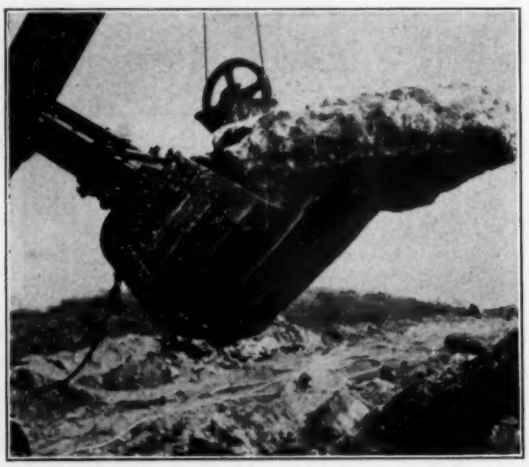
Manganese Steel Castings

Read this endorsement by one of the largest producers of crushed stone—Operating plants at Tomkins Cove, Haverstraw, Verplanck, New Hamburg and Marlborough, N. Y.—Over 5,000,000 tons capacity. The New York Trap Rock Corp. get

REMARKABLE SERVICE

Because "Indian" Manganese Steel has these higher wear resisting qualities—It is SUPERIOR.

—— "INDIAN" DIPPER ——
after nine years' service



"Indian" Manganese Steel Jaw and Gyratory Crusher Parts

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CHEEKS
TOGGLES
BEARINGS
CHUTES
SCREENS

For Long Life

PURCHASING DEPARTMENT

TELEPHONE
MURRAY HILL 2-6500-6511

NEW YORK TRAP ROCK CORPORATION
CRUSHED STONE
230 PARK AVENUE
NEW YORK, N.Y.

September 29, 1931

The Frog Switch & Mfg. Company,
60 East 42nd Street,
New York City.

Gentlemen:

The Carlisle Manganese Steel Dipper, furnished by you in March 1923 has rendered remarkable service. It was installed on our 30-B Bucyrus shovel at that time and is still in use on the same shovel.

Very truly yours,
NEW YORK TRAP ROCK CORP.
F. W. Tisdale
Purchasing Agent

Use "CARLISLE" REVERSIBLE TEETH

They Stand The Gaff

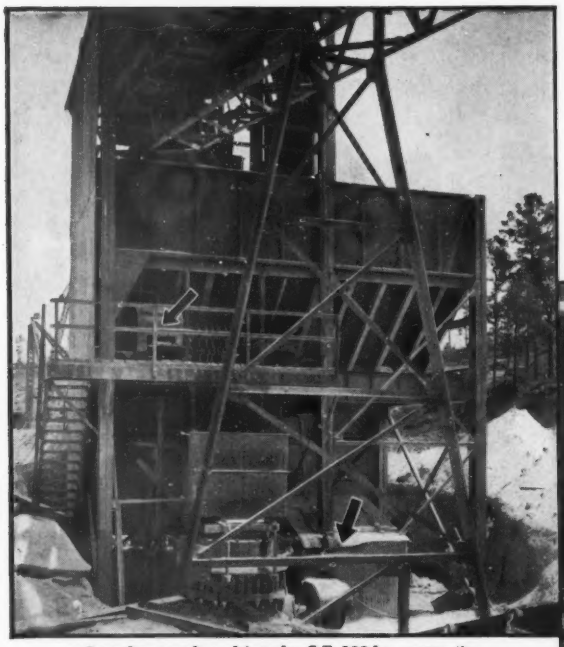
THE FROG, SWITCH & MANUFACTURING COMPANY

EST. 1881 MANGANESE STEEL DEPT. CARLISLE, PA.

E. L. PEMBERTON & CO., Agents
60 East 42nd St., New York City

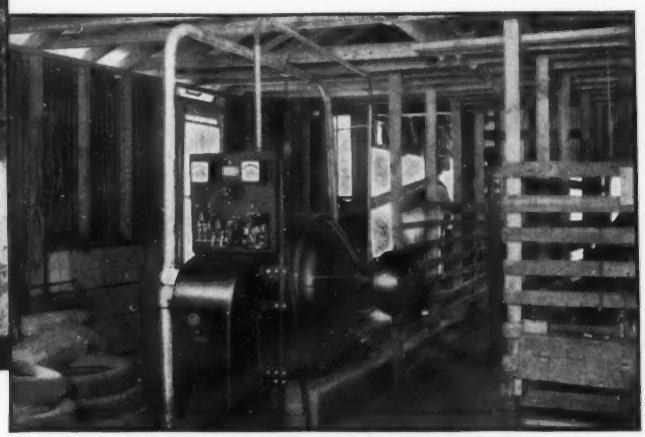
H. A. JOHANN, Agent
216 Rialto Bldg., St. Louis, Mo.

J. S. MORRISON CO., Agents
Oliver Bldg., Pittsburgh, Pa.



Secondary crusher, driven by G-E 100-hp. motor (in sheet-iron enclosure), fed by chain feeder operated by G-E 15-hp. motor (also enclosed)

Years of engineering and operating experience have made this new plant one of the finest in the south.



G-E 150-hp. synchronous motor with G-E control, Weston and Brooker Company, Camak, Ga.

G-E MOTORS

LICK THE TOUGHEST JOBS

The G-E Thrustor is one of our ten modernization "tools" designed to help you cut 1932 operating costs.

Are you familiar with these "tools"? If not, your nearest G-E office will be glad to tell you about them.

WESTON and Brooker Company put all the results of its many years of engineering and operating experience into its new crushed-stone plant at Camak, Georgia — and selected G-E motors and controllers.

The operating economy, the satisfaction, produced at this modern plant by General Electric combinations of the RIGHT MOTOR and the RIGHT CONTROL for the job, can be duplicated in your plant by modernization, and through the coöperation of G-E specialists in motorization. In replacing obsolete equipment, or in considering new, consult your nearest G-E office.

MODERNIZATION REDUCES COST . INCREASES PROFIT

200-558

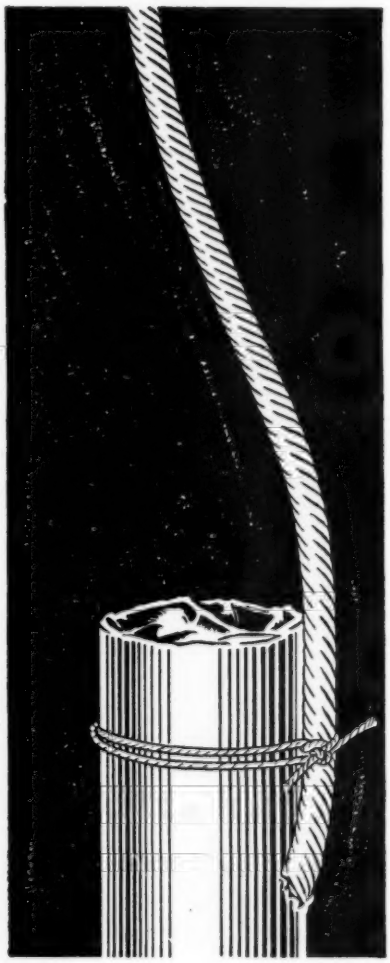
GENERAL ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

SAFETY IS THE SIGN OF SKILL

A few extra inches to extend well out of the hole is certainly less expensive than the trouble caused by skinners, which often results in premature shots.

DON'T SHORT FUSE



Shooting stone is safe if it is handled skillfully. And skill here is CARE in every operation from drilling the holes to lighting the fuse. A skillful powder man is always careful: and one of his first rules for safety is to cut enough fuse.

Ensign-Bickford Fuse is made carefully to standards which are uniform. There are a number of brands of Ensign-Bickford fuse, each designed to meet different mine conditions. You may find that a particular brand will be fully equal to what you are now using—and yet result in considerable saving. We shall be glad to discuss this matter with you. The Ensign-Bickford Company, Simsbury, Conn.

ENSIGN-BICKFORD *Safety* FUSE

RUFUS H. DARBY PRINTING CO., INC.
WASHINGTON, D. C.